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Claims:

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1. A method of forming a metal product, comprising the steps of: providing a metal alloy workpiece substrate have pre-process dimensions; determining dimensional differences between the pre-process dimensions of the workpiece substrate and desired post-process

5 dimensions of a post-process metal product formed from the workpiece substrate;

6 determining a build-up thickness of coating material required to obtain the desired post-

process dimensions of the post-process metal product; performing a high-density coating

process to coat the workpiece substrate with a coating material to build-up a thickness of

9 coating material effective to obtain desired finished dimensions after performing a

sintering heat treatment process and a hot isostatic pressing treatment; performing the

sintering heat treatment on the coated workpiece substrate to densify the coating material;

and then performing the hot isostatic pressing treatment to obtain the post-process metal

product having the desired post-process dimensions and having diffusion bonding

between the coating material and the workpiece substrate.

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2) A method of forming a metal product according to claim 1; wherein the metal alloy workpiece substrate comprises a nickel or cobalt-base superalloy; and the step of performing the high-density coating process comprises performing a high-density coating process such as a hyper velocity oxy fuel thermal spray process or a detonation gun





- process to apply a high-density coating having the same nickel or cobalt-base superalloy
- 2 composition as the metal alloy workpiece substrate.

- 4 3) A method of forming a metal product according to claim 2; wherein the step of
- 5 performing the sintering heat treatment comprises sintering at a temperature at or about
- 6 1825 to 2150 degrees F for about 1/2 to 2 hours.

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- 8 4) A method of forming a metal product according to claim 2; wherein the step of
- 9 performing the hot isostatic pressing treatment comprises hot isostatic pressing at a
- temperature of about 2200F in about 15 KSI argon for about 4 hours.

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- 12 5) A method of forming a metal product according to claim 1; wherein the step of hot
- isostatic pressing treatment comprises the step of heating the coated workpiece substrate
- 14 to a temperature that is substantially 80% of the melting point of the metal alloy; and
- pressurizing the coated workpiece substrate to a pressure substantially between 20 and 50
- percent of the yield strength of the metal alloy in an inert gas atmosphere.

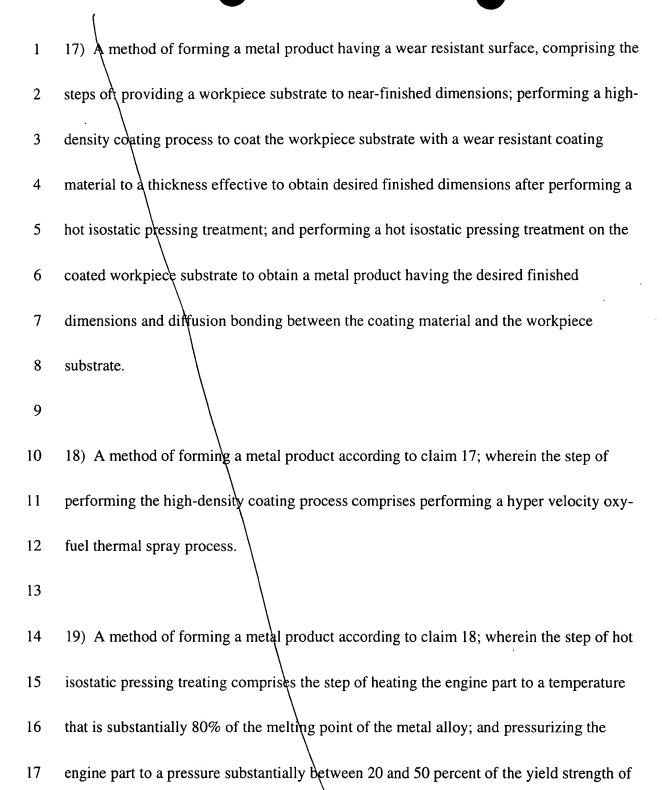
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6) A method of forming a metal product according to claim 1; wherein the coating 1 2 material built-up during the high-density coating process is comprised of the same metal 3 alloy as the workpiece substrate. 4 5 7) A method of forming a metal product according to claim 6; wherein the step of 6 performing the\sintering heat treatment comprises sintering at a temperature at or about 7 1825 to 2150 degrees F for about 1/2 to 2 hours. 8 9 8) A method of forming a metal product according to claim 7; wherein the step of 10 performing the hot isostatic pressing treatment comprises hot isostatic pressing at a 11 temperature of about 2200k in about 15 KSI argon for about 4 hours. 12 9) A method of forming a metal product, comprising the steps of: selecting attributes of 13 14 a final workpiece product; determining an appropriate substrate composition depending 15 on the selected attributes; forming a workpiece substrate to near-finished dimensions; 16 determining an appropriate coating material composition depending on the selected 17 attributes; preparing the workpiece substrate for a high-density coating process; 18 performing the high-density coating process to coat the workpiece substrate with the

coating material to a thickness effective to obtain desired finished dimensions after

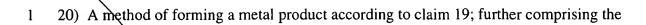
1	performing a hot isostatic pressing treatment; determining appropriate hot isostatic
2	pressing treatment parameters; and performing the hot isostatic pressing treatment on the
3	coated workpiece substrate to obtain a metal product having the desired finished
4	dimensions and diffusion bonding between the coating material and the workpiece
5	substrate.
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7	10) A method of forming a metal product according to claim 9; wherein the step of
8	performing the high-density coating process comprises performing a hyper velocity oxy-
9	fuel thermal spray process.
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11	11) A method of forming a metal product according to claim 10; wherein the step of hot
12	isostatic pressing treating comprises the step of heating the engine part to a temperature
13	that is substantially 80% of the melting point of the metal alloy; and pressurizing the
14	engine part to a pressure substantially between 20 and 50 percent of the yield strength of
15	the metal alloy in an inert gas atmosphere.
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17	12) A method of forming a metal product according to claim 11; wherein the step of
18	performing the hot isostatic pressing treatment comprises hot isostatic pressing at a
19	temperature of about 2200F in about 15 KSI argon for about 4 hours.

13) A method of forming a metal product according to claim 9; further comprising the 1 step of performing a sintering heat treatment on the coated workpiece substrate to densify 2 the coating material before performing the hot isostatic pressing treatment. 3 4 14) A method of forming a metal product according to claim 13; wherein the step of performing the sintering heat treatment comprises sintering at a temperature at or about 1825 to 2150 degrees F for about 1/2 to 2 hours. 8 9 15) A method of forming a metal product according to claim 9; wherein the workpiece 10 substrate comprises a nickel or cobalt-base superalloy; and the step of performing the 11 high-density coating process comprises performing a high-density coating process such 12 as a hyper velocity dxy-fuel thermal spray process or a detonation gun process to apply a 13 high-density coating having the same nickel or cobalt-base superalloy composition as the 14 workpiece substrate. 15 16 16) A method of forming a metal product according to claim 9; wherein the coating 17 material built-up during the high density coating process is comprised of a same metal 18 alloy as the workpiece substrate.



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the metal alloy in an inert gas atmosphere.



- 2 step of performing a sintering heat treatment on the coated workpiece substrate to densify
- 3 the coating material before performing the hot isostatic pressing treatment.

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